CLAIMS

What is claimed is:

1. A model of a molecule, the molecule including a first element, a second element in spaced relation from the first element, and a force acting on the first element and the second element along a vector, the model comprising:

a first elongated strand extending along a first path corresponding to the first element;

a second elongated strand extending along a second path spaced from the first path and corresponding to the second element; and

a connecting leg extending between the first elongated strand and the second elongated strand along a third path corresponding to the vector along which the force acts on the first element and the second element.

2. The model of claim 1 wherein the first elongated strand, the second elongated strand, and the connecting leg are made of a single piece of material.

3. The model of claim 1 wherein the model is fabricated using a solid free form fabrication method.

4. The model of claim 3 wherein the solid free form fabrication method is a one of stereolithography, selective laser sintering, fused deposition modeling, and laminated object manufacturing.

5. The model of claim 1 wherein the molecule includes a plurality of elements and wherein the first elongated strand corresponds to a first subset of the plurality of elements, wherein the second elongated strand corresponds to a second subset of the plurality of elements, and wherein a force acts on at least two of the plurality of elements.

6. The model of claim 5 wherein the plurality of elements is a plurality of alpha carbons and wherein the force acting on the at least two of the plurality of elements is a hydrogen bond between at least two of the plurality of alpha carbons.

7. The model of claim 6 wherein the molecule includes a side chain and wherein the model includes a branch representing the side chain and coupled to at least one of the first elongated strand and the second elongated strand.

8. The model of claim 7 wherein the molecule includes a substrate and wherein the model includes a spherical member representing the substrate and coupled to at least one of the first elongated strand and the second elongated strand.

9. The model of claim 8 wherein at least one of the first elongated strand, the second elongated strand, the connecting leg, the branch, and the spherical member are color-coded according to an atomic color scheme.

10. The model of claim 9 wherein the atomic color scheme is the Corey, Pauling, Kultin color scheme.

11. The model of claim 9 wherein the atomic color scheme includes at least one of gray representing carbon, white representing hydrogen, red representing oxygen, blue representing nitrogen, orange representing iron or phosphorus, and yellow representing sulfur.

12. The model of claim 1 wherein the model includes at least two segments and wherein the at least two segments have respective ends having engagement surfaces affording interconnection of the at least two segments.

13. The model of claim 12 wherein one of the at least two segments includes a male slide connector engagement surface and the other of the at least two segments includes a female slide connector engagement surface.

14. The model of claim 13 wherein the male slide connector engagement surface and the female slide connector engagement surface are adapted to be interconnected in a single orientation.

15. The model of claim 12 wherein the engagement surfaces are joined with a deformable piece of material, allowing the segments to move with respect to one another, while preventing the segments from completely separating from one another.

16. The model of claim 1 wherein the molecule is a protein.

17. The model of claim 16 wherein the protein is a one of adenosine tri-phosphate-ase, beta-globin, calmodulin, chymotrypsin, green fluorescent protein, human immunodeficiency virus protease, lysozyme, myosin, p53, zif268, zinc finger, major histocompatibility complex, immunoglobulin, lac repressor, and beta-galactosidase.

18. A model of a molecule, the molecule including a plurality of alpha carbons and a plurality of bonds delineating a first three-dimensional path, the model comprising:

a first elongated tubular strand representing the plurality of alpha carbons and the plurality of bonds and extending along the first three-dimensional path.

19. The model of claim 18 wherein the molecule includes a plurality of alpha carbons and a plurality of bonds delineating a second three-dimensional path, and wherein the model further comprises a second elongated tubular strand representing the plurality of alpha carbons and the plurality of bonds and extending in spaced relation to the first elongated tubular strand along the second three-dimensional path.

20. The model of claim 19 wherein the molecule includes a hydrogen bond, and wherein a connecting leg representing the hydrogen bond is coupled between the first elongated tubular strand and the second elongated tubular strand.

21. The model of claim 20 wherein the first elongated strand, the second elongated strand, and the connecting leg are made of a single piece of material.

22. The model of claim 20 wherein the molecule includes a side chain and wherein the model includes a branch representing the side chain and coupled to at least one of the first elongated strand and the second elongated strand.

23. The model of claim 22 wherein the molecule includes a substrate and wherein the model includes a spherical member representing the substrate and coupled to at least one of the first elongated strand and the second elongated strand.

24. The model of claim 23 wherein at least one of the first elongated strand, the second elongated strand, the connecting leg, the branch, and the spherical member are color-coded according to an atomic color scheme.

25. The model of claim 24 wherein the atomic color scheme is the Corey, Pauling, Kultin color scheme.

26. The model of claim 24 wherein the atomic color scheme includes at least one of gray representing carbon, white representing hydrogen, red representing oxygen,

blue representing nitrogen, orange representing iron or phosphorus, and yellow representing sulfur.

27. The model of claim 19 wherein the first elongated tubular strand includes at least two first strand segments, each of the at least two first strand segments having an end providing an engagement surface adapted to mate with an engagement surface of the other of the at least two first strand segments.

28. The model of claim 27 wherein the second elongated tubular strand includes at least two second strand segments, each of the at least two second strand segments having an end providing an engagement surface adapted to mate with an engagement surface of the other of the at least two second strand segments.

29. The model of claim 28 wherein one of the at least two first strand segments and one of the at least two second strand segments includes a male slide connector engagement surface and the other of the at least two first strand segments and the at least two second strand segments includes a female slide connector engagement surface.

30. The model of claim 29 wherein the male slide connector engagement surface and the female slide connector engagement surface are adapted to be interconnected in a single orientation.

31. The model of claim 28 wherein the engagement surfaces are joined with a deformable piece of material, allowing the at least two first strand segments and the at least two second strand segments to move with respect to one another, while preventing the at least two first strand segments and the at least two second strand segments from completely separating from one another.

32. The model of claim 18 wherein the model is fabricated using a solid free form fabrication method.

33. The model of claim 32 wherein the solid free form fabrication method is a one of stereolithography, selective laser sintering, fused deposition modeling, and laminated object manufacturing.

34. The model of claim 18 wherein the molecule is a protein.

35. The model of claim 34 wherein the protein is a one of adenosine tri-phosphate-ase, beta-globin, calmodulin, chymotrypsin, green fluorescent protein, human immunodeficiency virus protease, lysozyme, myosin, p53, zif268, zinc finger, major histocompatibility complex, immunoglobulin, lac repressor, and beta-galactosidase.

36. A model of a molecule, the molecule having a first set of alpha carbons, a second set of alpha carbons, and a hydrogen bond acting on one alpha carbon of the first set of alpha carbons and one alpha carbon of the second set of alpha carbons, the model comprising:

a first elongated strand extending along a first path corresponding to the first set of alpha carbons;

a second elongated strand extending along a second path corresponding to the second set of alpha carbons; and

a connecting leg extending between the first elongated strand and the second elongated strand along a path corresponding to the hydrogen bond.

37. The model of claim 36 wherein the first elongated strand, the second elongated strand, and the connecting leg are made of a single piece of material.

38. The model of claim 36 wherein the model is fabricated using a solid free form fabrication method.

39. The model of claim 38 wherein the solid free form fabrication method is a one of stereolithography, selective laser sintering, fused deposition modeling, and laminated object manufacturing.

40. The model of claim 36 wherein the molecule includes a side chain and wherein the model includes a branch representing the side chain and coupled to at least one of the first elongated strand and the second elongated strand.

41. The model of claim 40 wherein the molecule includes a substrate and wherein the model includes a spherical member representing the substrate and coupled to at least one of the first elongated strand and the second elongated strand.

42. The model of claim 41 wherein at least one of the first elongated strand, the second elongated strand, the connecting leg, the branch, and the spherical member are color-coded according to an atomic color scheme.

43. The model of claim 42 wherein the atomic color scheme is the Corey, Pauling, Kultin color scheme.

44. The model of claim 42 wherein the atomic color scheme includes at least one of gray representing carbon, white representing hydrogen, red representing oxygen, blue representing nitrogen, orange representing iron or phosphorus, and yellow representing sulfur.

45. The model of claim 36 wherein the model includes at least two segments and wherein the at least two segments have respective ends having engagement surfaces affording interconnection of the at least two segments.

46. The model of claim 45 wherein one of the at least two segments includes a male slide connector engagement surface and the other of the at least two segments includes a female slide connector engagement surface.

47. The model of claim 46 wherein the male slide connector engagement surface and the female slide connector engagement surface are adapted to be interconnected in a single orientation.

48. The model of claim 45 wherein the engagement surfaces are joined with a deformable piece of material, allowing the at least two segments to move with respect to one another, while preventing the at least two segments from completely separating from one another.

49. The model of claim 36 wherein the molecule is a protein.

50. The model of claim 49 wherein the protein is a one of adenosine tri-phosphate-ase, beta-globin, calmodulin, chymotrypsin, green fluorescent protein, human immunodeficiency virus protease, lysozyme, myosin, p53, zif268, zinc finger, major histocompatibility complex, immunoglobulin, lac repressor, and beta-galactosidase.

51. A macro-molecule construction kit, the kit comprising:

a plurality of amino acid backbone units, each one of the plurality of amino acid backbone units representing an assembly of atoms;

a plurality of hydrogen bond units coupleable to each one of the plurality of amino acid backbone units; and

a plurality of side chain units coupleable to each one of the plurality of amino acid backbone units.

52. The kit of claim 51 wherein each one of the plurality of amino acid backbone units includes a plurality of spherical members representing each atom of the assembly of atoms and a plurality of tubular members representing bonds between each atom of the assembly of atoms.

53. The kit of claim 52 wherein the plurality of spherical members includes a first spherical member representing a nitrogen atom, a second spherical member representing an alpha carbon atom, a third spherical member representing a carbonyl carbon atom, and a fourth spherical member representing an oxygen atom.

54. The kit of claim 53 wherein the first spherical member representing the nitrogen atom includes a first female engagement surface having a first shape coupleable to each one of the plurality of hydrogen units, and a second female engagement surface having a second shape coupleable to the third spherical member representing the carbonyl carbon atom of each one of the plurality of amino acid backbone units.

55. The kit of claim 54 wherein the first shape is a spherical shape representing a hydrogen bond and the second shape is a double spherical shape representing a covalent peptide bond, the double spherical shape adapted to allow insertion into the female engagement surface in one of two orientations.

56. The kit of claim 54 wherein the second spherical member representing the alpha carbon atom includes a female engagement surface having a third shape coupleable to each one of the plurality of side chains.

57. The kit of claim 56 wherein the third shape is a spherical shape representing a covalent bond.

58. The kit of claim 56 wherein the third spherical member representing the carbonyl carbon atom includes a male engagement surface having the second shape and coupleable to the first spherical member representing the nitrogen atom of each one of the plurality of amino acid backbone units.

59. The kit of claim 58 wherein the fourth spherical member representing the oxygen atom includes a female engagement surface having the first shape coupleable to each one of the plurality of hydrogen bond units.

60. The kit of claim 59 wherein each one of the plurality of the hydrogen bond units includes a spherical member coupled between a first male engagement surface having the first shape and a second male engagement surface having the first shape, the first male engagement surface and the second male engagement surface lying within a straight line.

61. The kit of claim 60 wherein each one of the plurality of side chain units includes at least one spherical member and at least one male engagement surface having the third shape coupleable to the female engagement surface having the third shape of the second spherical member representing the alpha carbon atom of each one of the plurality of amino acid units.

62. The kit of claim 53 wherein each one of the plurality of amino acid units includes a first plane within which the first spherical member, the second spherical member, and the third spherical member lie, and a second plane in which the second spherical member, the third spherical member, and the fourth spherical member lie.

63. The kit of claim 62 wherein the first plane is rotated with respect to the second plane about a tubular member representing a bond between the alpha carbon atom and the carbonyl carbon atom.

64. The kit of claim 53 wherein each one of the plurality of amino acid units includes a phi angle of rotation about a tubular member representing a bond between the nitrogen atom and the alpha carbon atom, and a psi angle of rotation about a tubular member representing a bond between the alpha carbon atom and the carbonyl carbon.

65. The kit of claim 64 wherein the kit is an alpha helix construction kit, and wherein the phi angle is approximately negative 57 degrees and the psi angle is approximately negative 47 degrees.

66. The kit of claim 65 wherein the alpha helix construction kit includes approximately 47 individual units, wherein the plurality of amino acid units includes approximately 12 of the 47 individual units, wherein the plurality of hydrogen bond units includes approximately 15 of the 47 individual units, and wherein the plurality of side chain units includes approximately 20 of the 47 individual units, so that when the alpha helix construction kit is assembled, the alpha helix construction kit represents one and a half turns of a right-handed alpha helix.

67. The kit of claim 64 wherein the kit is a beta sheet construction kit, and wherein the plurality of amino acid backbone units includes a plurality of parallel backbone units, each one of the plurality of parallel backbone units having a phi angle of approximately negative 119 degrees and a psi angle of approximately positive 113 degrees, and wherein the plurality of amino acid backbone units includes a plurality of anti-parallel backbone units, each one of the plurality of anti-parallel backbone units having a phi angle of approximately negative 139 degrees and a psi angle of approximately positive 135 degrees.

68. The kit of claim 67 wherein the beta sheet construction kit includes approximately 104 individual units, wherein the plurality of parallel backbone units includes approximately 28 of the 104 individual units, wherein the plurality of anti-parallel backbone units includes approximately 28 of the 104 individual units, wherein the plurality of hydrogen bond units includes approximately 20 of the 104 individual units, and wherein the plurality of side chain units includes approximately 28 of the 104 individual units.

69. The kit of claim 51 wherein the plurality of side chain units represents at least two of glycine, alanine, valine, leucine, isoleucine, serine, threonine, cysteine, methionine, proline, asparitic acid, asparagine, glutamic acid, glutamine, lysine, arginine, histidine, phenylalanine, tyrosine, and tryptophan.

70. The kit of claim 51 wherein at least one of the plurality of amino acid backbone units, the plurality of hydrogen bond units, and the plurality of side chain units is color-coded according to an atomic color scheme.

71. The model of claim 70 wherein the atomic color scheme is the Corey, Pauling, Kultin color scheme.

72. The model of claim 70 wherein the atomic color scheme includes at least one of gray representing carbon, white representing hydrogen, red representing oxygen, blue representing nitrogen, orange representing iron or phosphorus, and yellow representing sulfur.

73. A nucleic acid construction kit, the kit comprising:

a plurality of base units, each one of the plurality of base units representing an assembly of atoms,

a plurality of hydrogen bond units coupleable between each one of the plurality of base units;

a plurality of sugar units representing an assembly of atoms and coupleable to each one of the plurality of base units; and

a plurality of phosphate units representing an assembly of atoms and coupleable to each one of the plurality of sugar units.

74. The kit of claim 73 wherein the plurality of base units includes a plurality of cytosine units, a plurality of guanine units, and a plurality adenine units.

75. The kit of claim 74 wherein each one of the plurality of cytosine units includes a plurality of spherical members representing an assembly of atoms, the assembly of atoms including four carbon atoms, three nitrogen atoms, and one oxygen atom, and a plurality of tubular members representing bonds between each atom of the assembly of atoms.

76. The kit of claim 75 wherein a spherical member representing one of the nitrogen atoms includes a female engagement surface having a receptor shape, wherein a spherical member representing another of the nitrogen atoms includes a female engagement surface having a donor shape, wherein a spherical member representing another of the nitrogen atoms includes a female engagement surface having a slide connector shape, and wherein a spherical member representing the oxygen atom includes a female engagement surface having a receptor shape.

77. The kit of claim 74 wherein each one of the plurality of guanine units includes a plurality of spherical members representing an assembly of atoms, the assembly of atoms including five carbon atoms, five nitrogen atoms, and one oxygen atom, and a plurality of tubular members representing bonds between each atom of the assembly of atoms.

78. The kit of claim 77 wherein two spherical members representing two of the nitrogen atoms include a female engagement surface having a donor shape, wherein a spherical member representing another of the nitrogen atoms includes a female engagement surface having a slide connector shape, and wherein a spherical member representing the oxygen atom includes a female engagement surface having a receptor shape.

79. The kit of claim 74 wherein each one of the plurality of adenine units includes a plurality of spherical members representing an assembly of atoms, the assembly of atoms including five carbon atoms and five nitrogen atoms, and a plurality of tubular members representing bonds between each atom of the assembly of atoms.

80. The kit of claim 79 wherein a spherical member representing one of the nitrogen atoms includes a female engagement surface having a donor shape, wherein a spherical member representing another of the nitrogen atoms includes a female engagement surface having a receptor shape, and wherein a spherical member representing another of the nitrogen atoms includes a female engagement surface having a slide connector shape.

81. The kit of claim 74 wherein the kit is a deoxyribonucleic acid construction kit, wherein the plurality of base units includes a plurality of thymine units, and wherein the plurality of sugar units is a plurality of deoxyribose units.

82. The kit of claim 81 wherein each one of the plurality of thymine units includes a plurality of spherical members representing an assembly of atoms, the assembly of atoms including five carbon atoms, two nitrogen atoms, and two oxygen atoms, and a plurality of tubular members representing bonds between each atom of the assembly of atoms.

83. The kit of claim 82 wherein a spherical member representing one of the nitrogen atoms includes a female engagement surface having a donor shape, wherein a spherical member representing another of the nitrogen atoms includes a female engagement surface having a slide connector shape, and wherein a spherical member representing one of the oxygen atoms includes a female engagement surface having a receptor shape.

84. The kit of claim 81 wherein each one of the plurality of deoxyribose units includes a plurality of spherical members representing an assembly of atoms, the assembly of atoms including five carbon atoms and one oxygen atom, and a plurality of tubular members representing bonds between each atom of the assembly of atoms.

85. The kit of claim 84 wherein five of the plurality of spherical members represent carbon atoms in each one of a 1', 2', 3', 4', and 5' position according to deoxyribose ring structure.

86. The kit of claim 85 wherein a spherical member representing a carbon atom in the 1' position, a spherical member representing a carbon atom in the '3 position, and a spherical member representing a carbon atom in the 5' position each include a male engagement surface having a slide connector shape.

87. The kit of claim 86 wherein each one of the plurality of base units lies in a first plane and each one of the plurality of deoxyribose units generally lies in a second plane, and wherein the first plane is approximately perpendicular to the second plane when each one of the base units is coupled to a spherical member representing the carbon atom in the 1' position of each one of the plurality of deoxyribose units.

88. The kit of claim 74 wherein the kit is a ribonucleic acid construction kit, wherein the plurality of base units includes a plurality of uracil units, and wherein the plurality of sugar units includes a plurality of ribose units.

89. The kit of claim 88 wherein each one of the plurality of uracil units includes a plurality of spherical members representing an assembly of atoms, the assembly of atoms including four carbon atoms, two nitrogen atoms, and two oxygen atoms, and a plurality of tubular members representing bonds between each atom of the assembly of atoms.

90. The kit of claim 89 wherein a spherical member representing one of the nitrogen atoms includes a female engagement surface having a donor shape, wherein a spherical member representing another of the nitrogen atoms includes a female engagement surface having a slide connector shape, and wherein a spherical member representing one of the oxygen atoms includes a female engagement surface having a receptor shape.

91. The kit of claim 88 wherein each one of the plurality of ribose units includes a plurality of spherical members representing an assembly of atoms, the assembly of atoms including five carbon atoms and one oxygen atom, and a plurality of tubular members representing bonds between each atom of the assembly of atoms.

92. The kit of claim 91 wherein five of the plurality of spherical members represent carbon atoms in each one of a 1', 2', 3', 4', and 5' position according to ribose ring structure.

93. The kit of claim 92 wherein a spherical member representing a carbon atom in the 1' position, a spherical member representing a carbon atom in the '3 position, and a spherical member representing a carbon atom in the 5' position each include a male engagement surface having a slide connector shape.

94. The kit of claim 73 wherein each one of the plurality of hydrogen bond units includes a spherical member coupled between a first male engagement surface having a donor shape and a second male engagement surface having a receptor shape, the first male engagement surface and the second male engagement surface lying in a straight line.

95. The kit of claim 73 wherein each one of the plurality of phosphate units includes a plurality of spherical members representing an assembly of atoms, the assembly of atoms including four oxygen atoms and one phosphorus atom, and a plurality of tubular members representing bonds between each atom of the assembly of atoms.

96. The kit of claim 95 wherein two spherical members representing two of the oxygen atoms include a female engagement surface having a slide connector shape.

97. The kit of claim 95 wherein each one of the plurality of phosphate units is coupleable to each one of the plurality of sugar units in order to form each one of a 5' to 3' helix, a 5' to 1' helix, and a 3' to 1' helix.

98. The kit of claim 97 wherein a right-handed deoxyribonucleic acid model is only assembled when each one of the plurality of phosphate units is coupled to each one of the sugar units to form the 5' to 3' helix.

99. The kit of claim 73 wherein the nucleic acid construction kit includes approximately 130 individual units, wherein the plurality of base units includes approximately 30 of the 130 individual units, wherein the plurality of hydrogen bond units includes approximately 70 of the 130 individual units, wherein the plurality of sugar units includes approximately 15 of the 130 individual units, and wherein the plurality of phosphate units includes approximately 15 of the 130 individual units.

100. The model of claim 73 wherein at least one of the plurality of base units, the plurality of hydrogen bond units, and the plurality of sugar units are color-coded according to an atomic color scheme.

101. The model of claim 100 wherein the atomic color scheme is the Corey, Pauling, Kultin color scheme.

102. The model of claim 101 wherein the atomic color scheme includes at least one of gray representing carbon, white representing hydrogen, red representing oxygen, blue representing nitrogen, orange representing iron or phosphorus, and yellow representing sulfur.